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Abstract

We empirically analyse the impact of trade on income levels in the sub-Saharan African countries. The results indicate that the linkage between these two variables is negative for these countries. This outcome may explain the negative sign of the Africa dummy in income (or growth) regressions.

JEL Classification: F1, O24, O40
Key Words: Trade, Income Levels, Sub-Saharan Africa

1. Introduction and Benchmark Model Specification

There is an extensive theoretical and empirical literature on the potential gains from trade. If anything, the majority of studies show that trade is positively associated with economic growth rates. Prominent studies in this research area include Sachs and Warner (1995), Frankel and Romer (1999), and Dollar and Kraay (2002). However, the positive linkage is not undisputed. Rodrik et al. (2004), for instance, point out that once institutional quality is included in the model specification, the positive linkage between trade and growth disappears. This brief paper intends to contribute to that debate by examining the relationship between trade and income levels at a regional level, with a particular focus on sub-Saharan Africa,[1] which has surprisingly not been done in previous studies. Above all, we are interested in finding out whether African countries have truly been able to benefit from the well-known advantages of trade.

To address this question, we follow the literature and use a cross-sectional analysis with per-capita income as the dependent variable. Given the assumption that per-capita income levels were roughly similar in the very distant past, differences in current income levels reflect a diverging growth performance in the long run. By using income levels, we can interpret the estimates of the regressions as capturing the effects of the independent variables on growth in the very long run. The basic model is specified as follows:

$$\ln GNI_i = \alpha + \beta\, Trade_i + \gamma' X_i + e_i \qquad (1)$$

where GNI_i is per-capita income for country i, measured in PPP US dollars, *Trade* stands for the sum of imports and exports divided by GDP,[2] X_i is a set of further explanatory variables, including institutional quality (proxied by *Rule of Law*), and e_i is the error term. In addition to institutional quality and trade, we follow the previous literature and include the following measures for geography and market size as independent variables:[3]

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[1] Henceforth, Africa always refers to sub-Saharan Africa.

[2] We use trade in goods only, since information on trade in services is not available for a number of African countries.

[3] Trade and GNI data has been obtained from the World Bank's World Development Indicators 2005, while information on fractionalisation and the rule of law is taken from Alesina et al. (2003) and Kaufmann et al. (2005), respectively. All other data has been retrieved from the Dollar and Kraay (2002) dataset. We are grateful to Aart Kraay for providing his dataset.

- Distance from equator, measured as absolute value of latitude of the country's capital city (*Distance*)
- Dummy for landlocked countries (*Landlock*)
- Market size, measured as total population in millions (*Population*)
- Ethno-linguistic fractionalisation of the population, measured as the average of ethno and linguistic diversity (*Fractionalisation*)
- (Eight) regional dummies, following the World Bank classification of regions

The first two variables are related to the geography of a country, as geography may have an impact on incomes through agricultural productivity and morbidity rates. The distance from the equator can be interpreted as a proxy for various determinants of economic growth that relate to the climate. For example, a country with a tropical climate is more likely to suffer from higher morbidity rates and thus lower growth rates due to malaria or other tropical diseases. Thus, we expect a negative link with per-capita income. Being landlocked is likely to increase transport costs, reducing trade and other cross-border economic activities across borders, particularly in developing countries with poor infrastructure (which may also have a negative impact on income). The third variable, market size, may be another important determinant of per-capita income levels, since a large internal market is likely to be associated with increasing economic efficiency due to economies of scale, intensive competition and so on. We proxy market size with the total population since we cannot use total GDP, and expect a positive coefficient.

Additionally, we use a set of eight regional dummies to control for regional characteristics and an indicator for ethno-linguistic diversity as a further explanatory variable. Easterly and Levine (1997) show that ethno-linguistic diversity helps to explain differences across countries in public policies and various economic indicators. This is particularly the case in sub-Saharan Africa, where low economic growth is associated with low schooling, political instability, insufficient public infrastructure, underdeveloped financial systems, etc. According to their results, the degree of fractionalisation may well be an important determinant of differences in per-capita income levels. These results are basically confirmed

by the study of Alesina et al. (2003), who use an extended dataset for the degree of fractionalisation. Our data is taken from Alesina and associates.[4]

The year of observation for all variables is 2003, with the exception of the *Rule of Law* for which we use 2004 data. We include all countries for which we have data for the dependent and all independent variables. That leaves us with a sample of 146 countries, which is a relatively large dataset in comparison to some earlier studies. Since both trade and institutional quality are likely to be endogenous, we use an instrumental variable approach, employing a two-stage least squares (2SLS) estimation procedure. For openness to trade, we use the Frankel and Romer (1999) instrument for trade, that is, the fitted values of trade predicted by the exogenous variables in a gravity model, while for the quality of institutions (*Rule of Law*) we also follow the literature and employ the legal origin and the share of the population who speak English and/or a major European language.[5]

We start with a replication of one of the benchmark equations of Rodrik et al. (2004), reported in column 1 in Table 1. For our sample, we confirm the most important outcome of their analysis, that is, geographical variables do matter, trade does not and institutional quality dominates all other explanatory variables in explaining variations in per-capita income levels. Following this, we add the landlocked dummy and the indicator for fractionalisation (column 2). While the coefficient for the first variable has the expected negative sign it fails to significance at conventional levels. A higher degree of ethno-linguistic diversity is found to be negatively related to income levels. We then add the Africa dummy (column 3) as well as all other regional dummies (column 4). As expected in levels regressions, the Africa dummy is negative and strongly significant. Moreover, *Distance from Equator* and *Fractionalisation* partly lose their explanatory power as regional dummies are added.

We assess the validity of the instruments using the Sargan test for overidentifying restrictions and the Shea partial R^2 in first stage regressions. The results mean that our instruments are affecting income levels but only through *Trade* and *Rule of Law* and that they have sufficient

[4] While the data for fractionalisation has been obtained from Alesina et al. (2003), we computed the average for the two individual indicators ethno and linguistic diversity.

[5] We do not use settler mortality rates, as suggested by Acemoglu et al. (2001), since this would reduce our data sample roughly by half. The data for all instruments is also taken from the Dollar and Kraay dataset.

relevance for the right-hand side variables in the regressions. As a consequence, the chosen instruments are both valid and relevant for trade and institutional quality.

2. Extended Model Specification

To analyse the impact of trade on long-term growth for African countries, we extend the benchmark regressions and add an interactive term, that is, trade times the African dummy:

$$\ln GNI_i = \alpha + \beta\, Trade_i + \gamma' X_i + \phi\, Trade_i * Sub\text{-}Saharan\ Africa + e_i \qquad (2)$$

For this model specification, we always add the African dummy and the interactive term. In addition to the instruments used in the first set of regressions, we add an interactive term, consisting of the Frankel and Romer fitted trade indicator and the African dummy. Of particular interest is the estimate for ϕ. As can be seen from the results, reported in columns 5 to 8, the coefficient for the interactive term is negative and significant in all four model specifications. This outcome means that the impact of trade on per-capita income is negative for African countries. Importantly, the African dummy is no longer significant if we add the interactive term, meaning that openness to trade plays an important role in both explaining income levels in African countries as well as the significance of the dummy itself.

To check whether our results depend on our model specification or the data employed, we run numerous robustness checks. For example, we used further control variables that might explain the African economic performance, such as internal and external conflicts, governmental regulations, democracy, and so on, but the outcome is very similar. Likewise, we employed different definitions of income and openness to trade, for instance, income in current US dollars (rather than PPP US $) or trade including goods and services, but again the results do not change much.[6] In another set of regressions (not reported), we estimate the linkage between trade (and the other control variables) and per-capita income just for African countries. Though significance levels are slightly lower (around the 10 per cent level), the negative sign for *Trade* holds for African countries in all specifications.

[6] Note that using trade in goods and services would reduce our sample by eight countries, of which four are sub-Saharan African countries.

We do not claim that the negative linkage between trade and income holds for all African countries or that it will hold in the future. Rather, we find evidence that, on average, African countries were not likely to benefit from trade *in the past*, and argue that our results may offer an explanation for the negative sign of the African dummy in growth and income regressions.

Table 1: Trade and Income Levels, 2SLS Regressions, 2003

Independent variables	Dependent variable: ln GNI per capita, PPP US $, 2003							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trade	-0.24	-0.16	-0.32	-0.07	-0.24	-0.30	-0.30	0.02
	(-0.81)	(-0.59)	(-1.27)	(-0.29)	(-0.84)	(-0.98)	(-0.93)	(0.07)
Rule of Law	1.08***	0.90***	0.78***	0.84***	0.90***	0.85***	0.84***	0.87***
	(8.49)	(6.14)	(6.09)	(5.82)	(7.00)	(5.53)	(5.32)	(5.39)
Distance from Equator	0.01**	0.01**	0.01	0.002	0.01	0.01	0.01	0.01
	(2.09)	(2.14)	(1.58)	(0.75)	(0.93)	(1.26)	(1.33)	(1.01)
ln Population	0.10***	0.10***	0.05	0.09***	0.04	0.01	0.01	0.06
	(2.46)	(2.56)	(1.45)	(2.84)	(0.91)	(0.18)	(0.16)	(1.49)
Landlock		-0.16	-0.15	-0.11		-0.30	-0.31*	-0.24
		(-1.12)	(-1.11)	(-0.93)		(-1.58)	(-1.62)	(-1.61)
Fractionalisation		-0.78***	-0.12	0.00			0.01	0.06
		(-3.02)	(-0.44)	(0.01)			(0.02)	(0.21)
Trade*Africa					-1.65*	-2.37**	-2.37**	-1.77**
					(-1.80)	(-2.07)	(-2.06)	(-2.09)
Africa			-0.88***	-0.96***	0.06	0.53	0.52	0.25
			(-5.43)	(-3.47)	(0.10)	(0.74)	(0.74)	(0.39)
Other Regional Dummies	No	No	No	Yes	No	No	No	Yes
Joint F test on Trade and Trade*Africa (P-value)					4.00	5.18	4.99	4.11
					(0.04)	(0.02)	(0.03)	(0.04)
Shea partial R^2 (first-stage)								
Trade	0.24	0.23	0.22	0.23	0.27	0.28	0.26	0.30
Trade*Africa					0.14	0.12	0.12	0.15
Rule of Law	0.31	0.22	0.24	0.24	0.28	0.26	0.26	0.26
Hansen-Sargan overidentification test, χ^2(j) (P-value)	7.72	5.07	3.05	0.59	2.16	1.51	1.56	1.20
	(0.10)	(0.17)	(0.38)	(0.90)	(0.54)	(0.68)	(0.67)	(0.88)
R^2	0.70	0.75	0.79	0.84	0.73	0.67	0.68	0.78
Observations	146	146	146	146	146	146	146	146

Notes: Constant term is not shown; z values in parenthesis; significance at the 10, 5, and 1 per cent levels are denoted by *, **, ***, respectively.

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